JEE MAINS QFT2 2025

By: MelodyMan

Question Paper

Physics Single Correct (Maximum Marks: 80)

Question No. 1

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

In vernier callipers instrument 20 vernier scale divisions concide with 18 main scale divisions where $1 \text{ mm} = 1$ main scale division. The least count is:

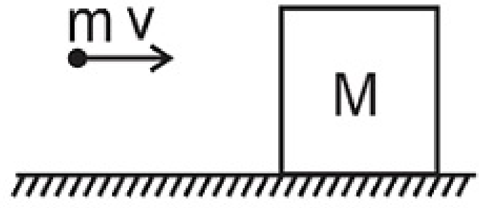
A. 0.02 mm
B. 0.05 mm
C. 0.1 mm
D. 0.2 mm

Question No. 2

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A bullet of mass m moving with a speed hits a stationary block of mass M at the topmost point and gets embedded in it. If friction is sufficient to prevent slipping then the block.



A. Must topple down
B. Must not topple down
C. May topple down
D. Will remain at rest

Question No. 3

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

In an LRC series circuit at resonance current in the circuit is $10\sqrt{2}$ A. If now frequency of the source is changed such that now current lags by $45°$ than applied voltage in the circuit, which of the following is correct :

A. Frequency must be increased and current after the change is 10 A
B. Frequency must be decreased and current after the change is 10 A
C. Frequency must be decreased and current is same as that of initial value

D. The given information is insufficient to conclude anything

Question No. 4

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The dimensions of magnetic field in M, L, T and C (coulomb) is given as.

A. $[\mathrm{MLT}^{-1}\mathrm{C}^{-1}]$

B. $[\mathrm{MT}^{2}\mathrm{C}^{-2}]$

C. $[\mathrm{MT}^{-1}\mathrm{C}^{-1}]$

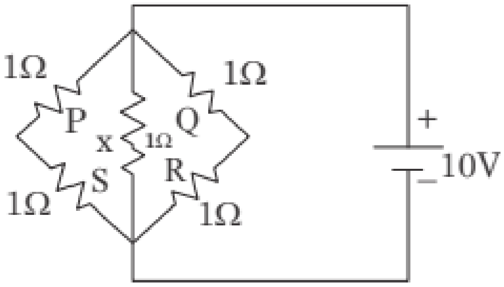
D. $[\mathrm{MT}^{-2}\mathrm{C}^{-1}]$

Question No. 5

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Choose the correct statement in the shown circuit: (all the resistors are of $1$ohms x: is the Resistor in the middle also of $1$ohms)



A. The maximum heat loss is observed in resistor " x ".
B. The current through Battery is 10 A.
C. The current through resistor " x " is zero.
D. None of these

Question No. 6

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A body of mass 32 kg is suspended by a spring balance from the roof of a vertically operating lift and going downward from rest. At the instants the lift has covered 20 m and 50 m, the spring balance showed 30 kg & 36 kg respectively. The velocity of the lift is:

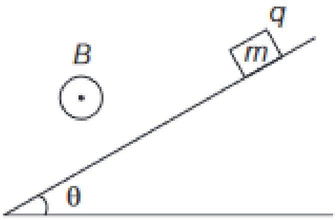
A. decreasing at 20 m & increasing at 50 m
B. increasing at 20 m & decreasing at 50 m
C. continuously decreasing at a constant rate throught the journey
D. continuously increasing at constant rate throughout the journey

Question No. 7

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A small block of mass 20 g and charge 4mC is released on a long smooth inclined plane of inclination angle of 45°, A uniform horizontal magnetic field of 1 T is acting parallel to the surface, as shown in the figure. The time from the start when the block loses contact with the surface of the plane is



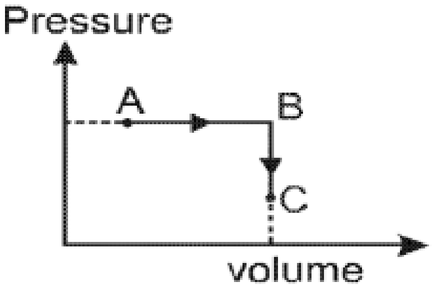
- A. 2 s
- B. 3 s
- C. 5 s
- D. 6 s

Question No. 8

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

In the process ABC for an ideal mono-atomic gas, the temperature at states A and C are equal. The heat released in the process BC is Q. The work done in the process A to B is equal to (AB is isobaric and BC is isochoric process) :



- A. Q
- B. $\frac{Q}{2}$
- C. $\frac{2Q}{3}$
- D. $\frac{3Q}{2}$

Question No. 9

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

If the wavelength of the first line of the Balmer series of hydrogen is 6561Å, find the wavelength of the second line of the series.

A. 13122Å
B. 3280Å
C. 4860Å
D. 2187Å

Question No. 10

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

In a diode, the diffusion current is $i_{\text{diffusion}}$ and drift current is i_{drift}, then match the column.

Column-I	Column-II
(1) Diode with no biasing	(p) $i_{\text{diffusion}} >> i_{\text{drift}}$
(2) Diode in forward bias	(q) $i_{\text{drift}} >> i_{\text{diffusion}}$
(3) Diode in reverse bias without breakdown	(r) $i_{\text{drift}} > i_{\text{diffusion}}$
(4) Diode in reverse bias with breakdown	(s) $i_{\text{drift}} = i_{\text{diffusion}}$

A. $A \to s, B \to q, C \to r, D \to p$
B. $A \to s, B \to p, C \to r, D \to q$
C. $A \to s, B \to q, C \to p, D \to r$
D. $A \to q, B \to p, C \to r, D \to s$

Question No. 11

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A body has maximum range R_1 when projected up the inclined plane. It has the maximum range R_2 when projected down the plane with same speed as in first case. Then which of the following is maximum range (R) for it when projected at certain angle with the horizontal ground and with same speed as in previous two cases?

A. $R = R_1 + R_2$
B. $R = R_2 - R_1$
C. $R = \frac{R_1 R_2}{R_1 + R_2}$
D. $R = \frac{2R_1 R_2}{R_1 + R_2}$

Question No. 12

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Suppose a container is evacuated to leave just one molecule of gas in it. Let, v_{a} and v_{rms} represent the average speed and the RMS speed of the gas.

A. $v_{\text{a}} > v_{\text{rms}}$
B. $v_{\text{a}} < v_{\text{rms}}$
C. $v_{\text{a}} = v_{\text{rms}}$
D. v_{rms} is undefined.

Question No. 13

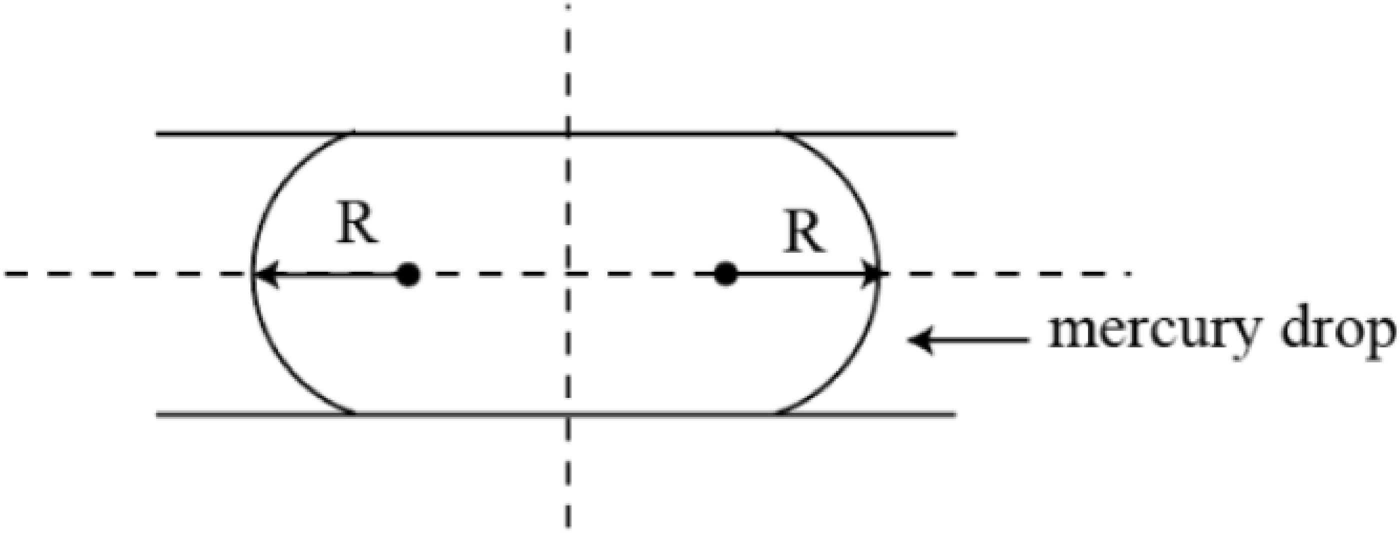
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

A circular freeway entrance and exit are commonly banked to control a moving car at 14 m/s . To design similar ramp for 28 m/s one should

A. increase the radius by factor 2
B. increase the radius by factor 4
C. decrease the radius by factor 4
D. decrease the radius by factor 2

Question No. 14
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

A mercury drop lies between two glass plates separated by a very small distance (see figure). Surface tension of mercury is T . Radius of curvature of drop surfaces in a direction parallel to plates is R. The other surfaces are flat. The excess pressure for the mercury drop is given by:



A. $\frac{T}{R}$
B. $\frac{2T}{R}$
C. $\frac{3T}{R}$
D. $\frac{4T}{R}$

Question No. 15
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

The power of biconvex lens is 10 dioptre and the radius of curvature of each surface is 10 cm. Then the refractive index of the material of the lens is :

A. $\frac{3}{2}$
B. $\frac{4}{3}$
C. $\frac{9}{8}$
D. $\frac{5}{3}$

Question No. 16

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The amplitude of electric field in a parallel beam of light of intensity 4 Wm^{-2} is ? (round off answer to nearest integer)

A. 50
B. 55
C. 60
D. 45

Question No. 17

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Two identical conducting spheres, A and B, have equal charges and are separated at a distance such that charge on each of them is essentially uniform on its surface. Athird identical conducting neutral sphere C, is brought in contact with A and then in contact with B and removed far away. If initial force between the two spheres A and B was F, then the new force between them would be (Assuming that in calculating both the forces, distance of separation remains same) $3F/P$, Find integral value of P.

A. 6
B. 10
C. 8
D. 12

Question No. 18

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A photon of wavelength 300 nm interacts with a stationary hydrogen atom in ground state. During the interaction, whole energy the photon is transferred to the electron of the atom. State which possibility is correct. (Consider, Plank constant = 4×10^{-15} eV_s, velocity of light = 3×10^{8}m/s, ionisation energy of hydrogen = 13.6eV)

A. Electron will be knocked out of the atom
B. Electron will go to any excited state of the atom
C. Electron will go only to lirst excited state of the atom
D. Electron will keep orbiting in the ground state of the atom

Question No. 19

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A simple pendulum has a time period T_1 when on the Earth's surface and T_2 when taken to a height R, above the Earth's surface, where R is the radius of the Earth. The value of $\frac{T_2}{T_1}$ is.

A. 1

B. $\sqrt{2}$
C. 4
D. 2

Question No. 20
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Two coils have a mutual induction 0.005 H. The current changes in the first coil according to the equation $i = i_m \sin \omega t$ where $i_m = 10\ \mathrm{A}$ and $\omega = 100\pi\ \mathrm{rad s^{-1}}$. The maximum value of the emf induced in the second coil is :

A. $5\pi V$
B. $4\pi V$
C. $2\pi V$
D. πV

Physics Numerical (Maximum Marks: 20)

Question No. 1
Numerical Type
The answer has to be filled into the input box provided below.

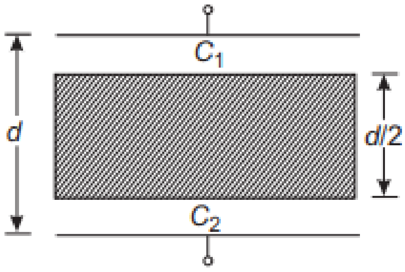
The intensity of magnetization of a bar magnet is $5.0 \times 10^4 \mathrm{Am^{-1}}$. The magnetic length and the area of cross-section of the magnet are $12 \mathrm{cm}$ and $1 \mathrm{cm^2}$ respectively. The magnitude of magnetic moment of this bar magnet is (in SI unit) M, find 10M.

Question No. 2
Numerical Type
The answer has to be filled into the input box provided below.

A wire of length $2\ \mathrm{m}$ is clamped horizontally between two fixed support. A mass $\mathrm{m} = 5\ \mathrm{kg}$ is hanged from middle of wire. What would be its vertical depression (in cm) in equilibrium?
(Young modulus of wire $= 2.4 \times 10^9\ \mathrm{N\ m^2}$, cross-sectional area $= 1\ \mathrm{cm^2}$) Roundoff answer to nearest integer.

Question No. 3
Numerical Type
The answer has to be filled into the input box provided below.

Two metal plates each of area ' A ' form a parallel plate capacitor with air in between the plates. The distance between the plates is ' d '. A metal plate of thickness $\frac{d}{2}$ and of same area A is inserted between the plates to form two capacitors of capacitances C_1 and C_2 as shown in the figure. If the effective capacitance of the two capacitors is C' and the capacitance of the capacitor initially is C, then $\frac{C'}{C}$ is



Question No. 4
Numerical Type
The answer has to be filled into the input box provided below.

The velocity of an object moving in a straight line path is given as a function of time by $v = 6t - 3t^2$, where v is in ms^{-1} , t is in s. The average velocity of the object between, $t = 0$ and $t = 2$ s is.....

Question No. 5
Numerical Type
The answer has to be filled into the input box provided below.

The densities of two solid spheres A and B of the same radii R vary with radial distance r as $\rho_A(\mathrm{r}) = \mathrm{k}\left(\frac{\mathrm{r}}{\mathrm{R}}\right)$ and $\rho_B(\mathrm{r}) = \mathrm{k}\left(\frac{\mathrm{r}}{\mathrm{R}}\right)^5$, respectively, where k is a constant. The moments of inertia of the individual spheres about axes passing through their centres are $\mathrm{I_A}$ and $\mathrm{I_B}$, respectively. If $\frac{\mathrm{I_B}}{\mathrm{I_A}} = \frac{\mathrm{n}}{10}$, the value of n is

Chemistry Single Correct (Maximum Marks: 80)

Question No. 1
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

In thin layer chromatography, a substance moved by a distance of 4 cm, where as the solvent moved by a distance of 5 cm. Then the value of retardation factor (R_f) is-

A. 0.8
B. 1.0
C. 9.0
D. 1.25

Question No. 2
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Match the following.

Column I	Column II
A. sp^3	(i) $[Co(NH_3)_6]^{3+}$
B. dsp^2	(ii) $[Ni(CO)_4]$
C. sp^3d^2	(iii) $[Pt(NH_3)_2Cl_2]$
D. dsp^3	(iv) $[CoF_6]^{3-}$
	(v) $[Fe(CO)_5]$

A *B* *C* *D* are respectively

A. (v) (ii) (iv) (iii)
B. (ii) (iii) (iv) (v)
C. (ii) (iii) (i) (v)
D. (iii) (ii) (iv) (i)

Question No. 3

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

For the cell reaction

$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(aq)$

$E^0_{cell} = 0.24\ V$ at 298 K. The standard Gibbs energy $(\Delta_r G^{-})$ of the cell reaction is:

[Given that Faraday constant $F = 96500\ Cmol^{-1}$]

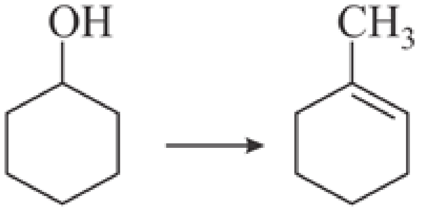
A. $-46.32\ kJ\ mol^{-1}$
B. $-23.16\ kJ\ mol^{-1}$
C. $46.32\ kJ\ mol^{-1}$
D. $23.16\ kJ\ mol^{-1}$

Question No. 4

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

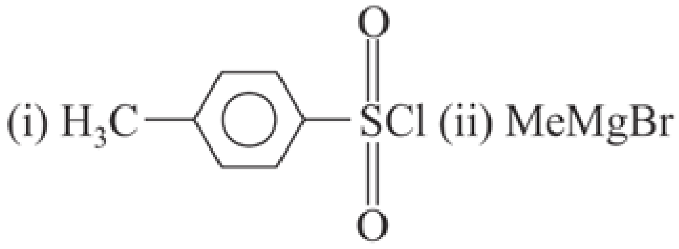
Which reaction condition would be best to perform the following transformation ?



A.

(i) PCC, (ii) MeMgBr, (iii) $POCl_3$

B.



C.

(i) HBr, (ii) Mg, (iii) MeI

D.

(i) NaOH, (ii) MeI

Question No. 5
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Which among the following is an example of ionization isomer?

A. $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$
B. $[Co(NH_3)_5NO_2]Cl$ and $[Co(NH_3)_5ONO]Cl_2$
C. $[Co(H_2O)_6]Cl_3$ and $[Co(H_2O)_5Cl]Cl_2.H_2O$
D. $[Co(NH_3)_3]$ $[Cr(CN)_6]$ and $[Cr(NH_3)_6]$ $[Co(CN)_6]$

Question No. 6
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Assume that the decomposition of HNO_3 is

$$4HNO_3(g) \rightleftharpoons 4NO_2(g) + 2H_2O(g) + O_2(g)$$

and the reaction approaches equilibrium at 400 K & 30 atm pressure. At equilibrium the partial pressure of HNO_3 is 2 atm. Find K_C at 400 K ($R = 0.08 \ell - \text{atm/K} - \text{mol}$)

A. 4
B. 8
C. 16
D. 32

Question No. 7
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Give the reactivity in the decreasing order of the following nucleophiles towards nucleophilic addition reaction with compound $A(F_3C-\equiv-CF_3)$.
(I) CH_3O^-

(II) $C_2H_5O^-$
(III) $CH_3COO^{\ominus}$
(IV) $CH_3SO_3^{\ominus}$

A. (II) > (I) > (III) > (IV)
B. (IV) > (III) > (I) > (II)
C. (I) > (II) > (IV) > (III)
D. (III) > (IV) > (II) > (I)

Question No. 8
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

A metal gives two chlorides A and B. A gives black precipitate with NH_4OH and B gives white. With KI, B gives a red precipitate soluble in excess of KI. A and B are respectively :

A. Hg_2Cl_2 and $HgCl_2$
B. $HgCl_2$ and Hg_2Cl_2
C. $HgCl_2$ and $ZnCl_2$
D. $ZnCl_2$ and $HgCl_{24}$

Question No. 9
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

An organic compound ' X ' on treatment with pyridinium chloro chromate in dichloromethane gives compound ' Y '. Compound ' Y ', reacts with I_2 and alkali to form triiodomethane. The compound ' X ' is.

A. C_2H_5OH
B. CH_3CHO
C. CH_3COCH_3
D. CH_3COOH

Question No. 10
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Which of the following compounds is colored and paramagnetic?

A. CuCl
B. $K_3[Cu(CN)_4]$
C. CuF_2
D. $[Cu(CH_3CN)_4]BF_4$

Question No. 11

Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Among the triatomic molecules/ions, $BeCl_2$, N_3^-, N_2O, NO_2^+, O_3, SCl_2, ICl_2^-, I_3^- and XeF_2, the total number of linear molecule(s)/ion(s) where the hybridization of the central atom does not have contribution from the d-orbital(s) is [Atomic number: $S = 16, Cl = 17, I = 53$ and $Xe = 54$]

A. 3
B. 5
C. 6
D. 4

Question No. 12
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Which of the following statement(s) is/are not true about the following decomposition reaction?
$2KClO_3 \rightarrow 2KCl + 3O_2$
(i) Potassium is undergoing oxidation
(ii) Chlorine is undergoing oxidation
(iii) Oxygen is reduced
(iv) None of the species are undergoing oxidation or reduction

A. (i) and (ii)
B. (i) and (iv)
C. (i) and (iii)
D. All of these

Question No. 13
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Assertion: PbO_2 is an oxidising agent and reduced to PbO .

Reason: Stability of Pb(II) > Pb(IV) on account of inert pair effect.

A. Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
B. Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.
C. Assertion is true but Reason is false.
D. Assertion is false but Reason is true.

Question No. 14
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

2 g of a non-electrolyte solute (molar mass is 500 g mol^{-1}) was dissolved in 57.3 g of xylene. If the freezing point depression constant K_f of xylene is $4.3 \text{ K kg mol}^{-1}$. Then, the depression in freezing point of xylene is..........

A. 57.3 K
B. 0.3 K
C. 4.3 K
D. 0.002 K

Question No. 15

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Evaluate the following statements about Group 13 elements:

(A) Atomic radius decreases down the group from B to TI in a regular manner.

(B) Electronegativity decreases gradually down the group from B to TI.

(C) Aluminium can form compounds with a covalency of 6 due to the presence of vacant d-orbitals.

(D) Compounds of boron, like boric acid (H_3BO_3), exhibit significant $p\pi - p\pi$ character.

(E) Boron and silicon exhibit similar chemical properties, such as covalent bonding and acidic oxide formation.

Choose the correct combination of statements from the options below:

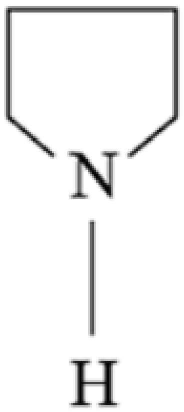
A. (A), (B), and (D) only
B. (B), (C), and (E) only
C. (C), (D), and (E) only
D. (B), (D), and (E) only

Question No. 16

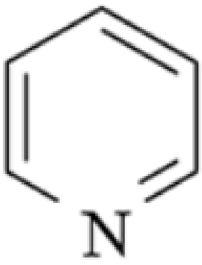
Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Consider the following compounds
Order of basicity of these compounds in decreasing order is



(1)



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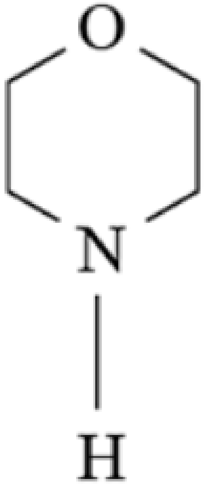

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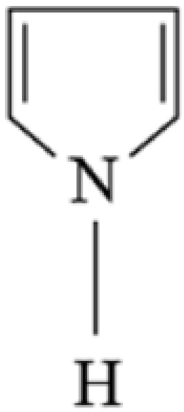


(4)

A. 4 > 1 > 2 > 3
B. 1 > 3 > 4 > 2
C. 2 > 3 > 4 > 1
D. 1 > 3 > 2 > 4

Question No. 17

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The correct option(s) to distinguish nitrate salts of Mn^{2+} and Cu^{2+} taken separately is (are)
(1) Mn^{2+} shows the characteristic green colour in the flame test
(2) only Cu^{2+} shows the formation of precipitate by passing H_2 S in acidic medium
(3) only Mn^{2+} shows the formation of precipitate by passing H_2 S in faintly basic medium
(4) $Cu^{2+} \mid Cu$ has higher reduction potential than $Mn^{2+} \mid Mn$ (measured under similar conditions)

A. 1,2
B. 1,3
C. 2,4
D. 1, 2, 4

Question No. 18

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A carbonyl compound of formula $C_9H_{10}O(A)$, which is a benzene derivative gives orange precipitate with 2,4 -D.N.P. and also gives yellow precipitate with I_2 in presence of aqueous NaOH. The total no. of isomers possible for 'A' are_____

A. 2
B. 4
C. 5
D. 3

Question No. 19

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

HCl gas is passed into water, yielding a solution of density 1.095 g mL^{-1} and containing 30% HCl by weight. Calculate the molarity of the solution.

A. 3
B. 6
C. 12
D. 9

Question No. 20

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

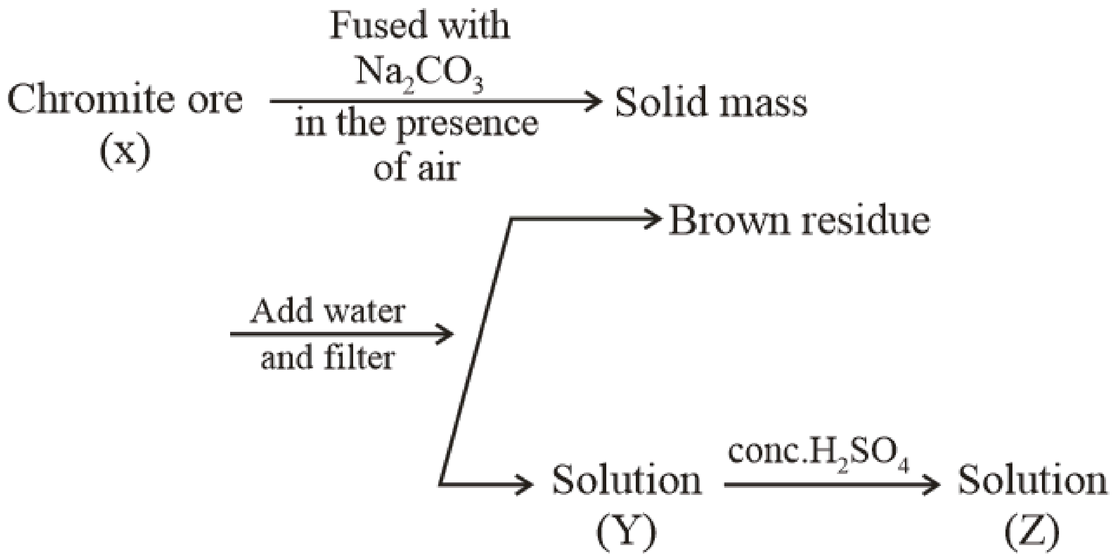
Which one of the following statements is correct?

A. Starch on complete hydrolysis gives fructose
B. Lactose on hydrolysis gives glucose and fructose
C. Glucose on slow oxidation to CO_2 and H_2O by enzyme does not liberate energy
D. Cellulose is not digestible in human body

Chemistry Numerical (Maximum Marks: 20)

Question No. 1
Numerical Type
The answer has to be filled into the input box provided below.

The following steps are involved in the manufacturing of potassium dichromate:



What is the difference in the oxidation number of Cr between X and Y?

Question No. 2
Numerical Type
The answer has to be filled into the input box provided below.

Find the quantum number 'n' corresponding to the excited state of He^+ ion, if on transition to the ground state that ion emits two photons in succession with wavelengths 108. 5 and 30. 4 nm.

Question No. 3
Numerical Type
The answer has to be filled into the input box provided below.

For a compound with empirical formula C_7H_8O, how many aromatic structures containing benzene group are possible?

Question No. 4

Numerical Type

The answer has to be filled into the input box provided below.

The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume

$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$

Experiment	Time/s^{-1}	Total pressure/ atm
1	0	0.5
2	100	0.6

Calculate y when the rate of the reaction $y \times 10^{-4}$ when total pressure is 0.65 atm .Given $(log5 = 0.699, log2 = 0.301)$

(round off to nearest integer)

Question No. 5

Numerical Type

The answer has to be filled into the input box provided below.

Identify the total number of atoms in product Q in the given sequence of reaction

$C_6H_5NH_2 \xrightarrow{NaNO_2+HCl} X \xrightarrow{Cu_2(CN)_2} Y \xrightarrow{H_2O/H^+} Z \xrightarrow{NaOH/CaO,\Delta} P \xrightarrow{Cl_2,\, h\nu(\text{ Excess })} Q$

Mathematics Single Correct (Maximum Marks: 80)

Question No. 1

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The sum of the roots (real or complex) of the equation $x^{2001} + (\frac{1}{2} - x)^{2001} = 0$ is.

A. 2000
B. 2001
C. 1000
D. 500

Question No. 2

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

If $f(\frac{2x+3}{3x+5}) = x + 4, x \neq \frac{-5}{3}, \frac{2}{3}$ and $\int f(x)dx = Ax + B\ln|3x-2| + C$, then $3B - A =$

A. $\frac{64}{9}$

B. $\frac{-52}{21}$
C. $\frac{-10}{3}$
D. $\frac{-8}{3}$

Question No. 3

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

If principal argument of z_0 satisfying $|z-3| \le \sqrt{2}$ and $\arg(z-5i) = \frac{-\pi}{4}$ simultaneously is θ, then identify the incorrect statement?

A. $|z_0| = \sqrt{17}$
B. $\tan 2\theta = \frac{8}{15}$
C. $\tan\theta = \frac{-1}{4}$
D. $|z_0 - 5i| = 4\sqrt{2}$

Question No. 4

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The minimum value of

$$f(x) = |x-1| + |2x-1| + |3x-1| + \ldots\ldots + |119x-1|$$

occurs at x. Then x is equal to-

A. $\frac{1}{84}$
B. $\frac{1}{51}$
C. $\frac{1}{80}$
D. $\frac{1}{94}$

Question No. 5

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The reflection of the point $P(1,0,0)$ in the line $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$ is--

A. $(3,-4,-2)$
B. $(5,-8,-4)$
C. $(1,-1,-10)$
D. $(2,-3,8)$

Question No. 6

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Let $A = \{1, 2, 3, 4\}$. Let R be a relation on A defined by xRy if and only if $x \leq 2y$.

Let m be the total number of elements in R.

Let n be the minimum number of elements to be added to make R symmetric, and p be the minimum number of elements to be added to make R reflexive.

Find $m + 2n + p$.

A. 17
B. 18
C. 19
D. 20

Question No. 7

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The orthocentre and the centroid of $\triangle ABC$ are $(5, 8)$ and $(3, \frac{14}{3})$ respectively. The equation of the side BC is $x - y = 0$. Given that the image of the orthocentre of a triangle with respect to any side lies on the circumcircle of that triangle, then the diameter of the circumcircle of $\triangle ABC$ is--

A. $\sqrt{10}$
B. $2\sqrt{10}$
C. $4\sqrt{10}$
D. $8\sqrt{10}$

Question No. 8

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Consider all rectangles lying in the region

$$\{(x, y) \in \mathrm{R} \times \mathrm{R} : 0 \leq x \leq \frac{\pi}{2} \text{ and } 0 \leq y \leq 2\sin(2x)\}$$

and having one side on the x-axis. The area of the rectangle which has the maximum perimeter among all such rectangles, is----

A. $\frac{3\pi}{2}$
B. π
C. $\frac{\pi}{2\sqrt{3}}$
D. $\frac{\pi\sqrt{3}}{2}$

Question No. 9

Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

The derivative of $\cos(2\tan^{-1}(\sqrt{\frac{1-x}{1+x}})) - 2\cos^{-1}(\sqrt{\frac{1-x}{2}})$ W. r. to x is

- A. $1 - \frac{1}{\sqrt{1-x^2}}$
- B. $1 - \frac{1}{\sqrt{1+x^2}}$
- C. $2 - \frac{1}{\sqrt{1-x^2}}$
- D. $2 - \frac{1}{\sqrt{1+x^2}}$

Question No. 10
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

The line $x + y = 1$ meets x-axis at A and y-axis at B, P is the mid-point of AB; P_1 is the foot of the perpendicular from P to OA; M_1 is that of P_1 on OP; P_2 is that of M_1 on OA; M_2 is that of P_2 on OP; P_3 is that of M_2 on OA; and so on.

If P_n denotes the n$^{\text{th}}$ foot of the perpendicular on OA; then OP_n is equal to

- A. $(\frac{1}{2})^{n-1}$
- B. $(\frac{1}{2})^{n}$
- C. $(\frac{1}{2})^{n+1}$
- D. none of these.

Question No. 11
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

A function $y = f(x)$ satisfies $(x + 1) \cdot f'(x) - 2(x^2 + x)f(x) = \frac{e^{x^2}}{(x+1)}, \forall x > -1$. If $f(0) = 5$, then $f(x)$ is

- A. $(\frac{3x+5}{x+1}) \cdot e^{x^2}$
- B. $(\frac{6x+5}{x+1}) \cdot e^{x^2}$
- C. $(\frac{6x+5}{(x+1)^2}) \cdot e^{x^2}$
- D. $(\frac{5-6x}{x+1}) \cdot e^{x^2}$

Question No. 12

Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

A is one among the 8 horses in a race. A is to be ridden by one of the 3 jockeys P, Q, R. If P rides A all the horses are equally likely to win, if Q rides A his chances are doubled and if R rides A his chance are tripled. A die is thrown. If 1 or 2 or 3 appears then P rides A, if 4 or 5 appears then Q rides A, other-wise R rides A. Then the probability that A wins is

A. $\frac{1}{12}$
B. $\frac{3}{16}$
C. $\frac{5}{24}$
D. $\frac{7}{48}$

Question No. 13
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

If A and B are square matrices of order 3 such that $|A| = 3$ and $|B| = 2$, then the value of $\left|A^{-1}\, adjB^{-1}\, adj(3A^{-1})\right|$ is equal to

A. 27
B. $\frac{27}{4}$
C. $\frac{1}{108}$
D. $\frac{1}{4}$

Question No. 14
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Let $ABCD$ is a parallelogram where $\overrightarrow{\mathrm{AB}} = \overrightarrow{\mathrm{a}}, \overrightarrow{\mathrm{AD}} = \overrightarrow{\mathrm{b}}, |\overrightarrow{\mathrm{a}}| = |\overrightarrow{\mathrm{b}}| = 2$ and $|\vec{a}\times\vec{b}| + \vec{a}\cdot\vec{b} = \sqrt{2}|\vec{a}||\vec{b}|$ $(\vec{a}\cdot\vec{b} > 0)$, then area of this parallelogram, is (in square units)-

A. $2\sqrt{2}$
B. 2
C. $\sqrt{2}$
D. $8\sqrt{2}$

Question No. 15
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

Number of vectors $\vec{V_1} = a_1\hat{i} + b_1\hat{j} + c_1\hat{k}$ and $\vec{V_2} = a_2\hat{i} + b_2\hat{j} + c_2\hat{k}$ such that $\vec{V_1}$ and $\vec{V_2}$ are mutually perpendicular, where $\mathbf{a}_1, \mathbf{b}_1, \mathbf{c}_1, \mathbf{a}_2, \mathbf{b}_2, c_2 \in \{-2, -1, 1, 2\}$ is equal to

A. 288
B. 278

- C. 164
- D. 184

Question No. 16

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

If radii of the smallest and largest circle passing through origin and touching the circle $x^2 + y^2 + 4x + 6y - 3 = 0$ are r_1 and r_2 respectively, then $r_1 r_2$ is equal to -

- A. $\frac{1}{4}$
- B. $\frac{7}{4}$
- C. $\frac{3}{4}$
- D. $\frac{9}{4}$

Question No. 17

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The range of the function $y = 2\sin^{-1}[x^2 + \frac{1}{2}] + \cos^{-1}[x^2 - \frac{1}{2}]$ is (where, $[\cdot]$ denotes the greatest integer function)

- A. $(0, \pi)$
- B. $[\pi, \frac{3\pi}{2}]$
- C. $\{\pi\}$
- D. $\{\pi, \frac{3\pi}{2}\}$

Question No. 18

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Let α and β be the roots of the equation $x^2 + 4x + 13 = 0$. Define $S_n = \alpha^n + \beta^n$. If: $4S_{10} = aS_9 - b$, find the value of $a + b$ given that: $S_{12} + 2S_{11} - 3S_{10} = 156$.

- A. 80
- B. 85
- C. 91
- D. 95

Question No. 19

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

If f(x) = $\lim_{a \to x}\left(\frac{e^{a^2+|x|-x^2} - e^{|x|}}{(a+x)\sin(a-x)}\right); \forall x \in R$ then number of roots of the equation $f(x)(|x^2 - 1|) = 1$ is

A. 2
B. 3
C. 4
D. 5

Question No. 20
Only One Option Correct Type
Each question has multiple options out of which ONLY ONE is correct.

All the words formed by writing all the letters of word ZENITH are arranged as in English dictionary. Now the position of word ZENITH is (from beginning)

A. 598
B. 602
C. 532
D. 616

Mathematics Numerical (Maximum Marks: 20)

Question No. 1
Numerical Type
The answer has to be filled into the input box provided below.

The sequence $\langle a_{n-1} \rangle, n \in N$ is an arithmetical progression and d is its common difference. If $\text{Lim}_{n\to\infty}\left(1-\frac{d^2}{a_1^2}\right)\left(1-\frac{d^2}{a_2^2}\right)\cdots\left(1-\frac{d^2}{a_n^2}\right)$ converges to $\frac{1}{4}$ and $a_1 = 8$, then find the value of d

Question No. 2
Numerical Type
The answer has to be filled into the input box provided below.

Given $a, b \in \{0, 1, 2, \ldots, 6\}$. Consider the system of equations

$x + y + z = 4$

$2x + y + 3z = 6$

$x + 2y + az = b$

If the number of ordered pairs (a, b), so that the system of equations has unique solution is λ, then the value of is $\frac{\lambda}{7}$ equal to

Question No. 3
Numerical Type
The answer has to be filled into the input box provided below.

Let $f[1,\infty) \to [2,\infty)$ be a differentiable function such that $f(1) = \frac{1}{3}$. If $6\int_1^x f(t)dt = 3xf(x) - x^3$ for all $x \geq 1$, then the value of $3f(2)$ is

Question No. 4
Numerical Type
The answer has to be filled into the input box provided below.

The shortest distance between the following pair of lines: $\vec{r} = \hat{i} + 2\hat{j} - 4\hat{k} + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$ and $\vec{r} = 3\hat{i} + 3\hat{j} - 5\hat{k} + \mu(2\hat{i} + 3\hat{j} + 6\hat{k})$ is $\frac{\sqrt{293}}{K}$. Find the value of K.

Question No. 5
Numerical Type
The answer has to be filled into the input box provided below.

The value of $\int_0^{100} \{\sqrt{x}\}dx$ (where $\{x\}$ is the fractional part of x is (mark answer to nearest integer)